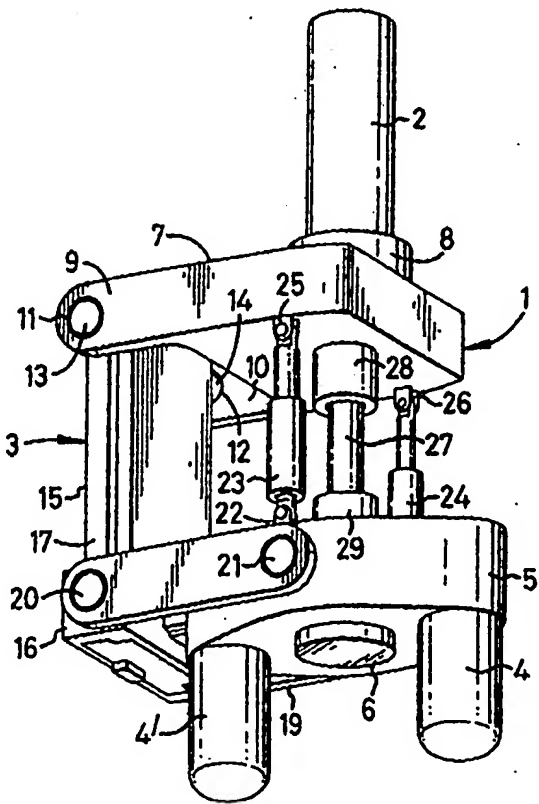


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(54) Title: AN APPARATUS FOR CONNECTING TUBULARS USING A TOP DRIVE (57) Abstract <p>An apparatus for facilitating the connection of tubulars using a top drive, said apparatus comprising a motor (4, 4') for rotating a tool (30) for drivingly engaging a tubular, and means (3) for connecting said motor (4, 4') to said top drive, the apparatus being such that, in use, said motor (4, 4') can rotate one tubular with respect to another to connect said tubular.</p> 		

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AN APPARATUS FOR CONNECTING TUBULARS USING A TOP DRIVE

This invention relates to an apparatus for facilitating the connection of tubulars using a top drive and is more particularly, but not exclusively, intended for facilitating the
5 connection of a section or stand of casing to a string of casing.

In the construction of oil or gas wells it is usually necessary to line the borehole with a string of tubulars known as a casing. Because of the length of the casing required, sections or stands of say two sections of casing are progressively added to the string as it is lowered into the well from a drilling platform. In particular, when it is
10 desired to add a section or stand of casing the string is usually restrained from falling into the well by applying the slips of a spider located in the floor of the drilling platform. The new section or stand of casing is then moved from a rack to the well centre above the spider. The threaded pin of the section or stand of casing to be connected is then located over the threaded box of the casing in the well and the
15 connection is made up by rotation there between. An elevator is then connected to the top of the new section or stand and the whole casing string lifted slightly to enable the slips of the spider to be released. The whole casing string is then lowered until the top of the section is adjacent the spider whereupon the slips of the spider are re-applied, the elevator disconnected and the process repeated.

20 It is common practice to use a power tong to torque the connection up to a predetermined torque in order to make the connection. The power tong is located on a platform, either on rails, or hung from a derrick on a chain. However, it has recently been proposed to use a top drive for making such connection. The normal use of such a top drive may be the driving of a drill string.

A problem associated with using a top drive for rotating tubulars in order to obtain a connection between tubulars is that some top drives are not specifically designed for rotating tubulars are not able to rotate at the correct speed or have non standard rotors.

5 According to the present invention there is provided an apparatus for facilitating the connection of tubulars using a top drive, said apparatus comprising a motor for rotating a tool for drivingly engaging a tubular, and means for connecting said motor to said top drive, the apparatus being such that, in use, said motor can rotate one tubular with respect to another to connect said tubulars.

10 Other features of the invention are set out in Claims 2 et seq.

For a better understanding of the present invention and in order to show how the same may be carried into effect reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 is a front perspective view of an apparatus in accordance with the
15 present invention; and

Figure 2 is a rear perspective view of the apparatus of Figure 1 in use.

Referring to Figure 1 there is shown an apparatus which is generally identified by reference numeral 1.

The apparatus 1 comprises a connecting tubular 2, a suspension unit 3 and a
20 hydraulic motor 4 and 4'. The hydraulic motor 4,4' has a stator 5 and a rotor 6 and is driven by a supply of pressurised hydraulic fluid (the fluid supply lines are not illustrated in the Figures). The suspension unit 3 suspends the hydraulic motor 4,4' from the connecting tubular 2.

The suspension unit 3 comprises a plate 7 which is fixed to the connecting tubular 2 by a collar 8. The plate 7 has two projections 9 and 10 which have holes 11 and 12 for accommodating axles 13 and 14, which are rotationally disposed therein. The axles 13 and 14 are integral with a rigid body 15. A slider 16 is arranged on 5 runners 17 and (not shown) on the rigid body 15. Arms 18 and 19 are connected at one end to the slider 16 via spherical bearings 20 and at the other end to each side of the stator 5 via spherical bearings 21 and 21'. The arms 18 and 19 are provided with lugs 22 and 22' to which one end of a piston and cylinder 23, 24 is attached and are movable thereabout. The other end of each piston and cylinder 23, 24 is attached to lugs 25, 26 10 respectively and is movable thereabout. A mud pipe 27 is provided between the plate 7 and the stator 5 for carrying mud to the inside of a tubular therebelow. The mud pipe 27 comprises curved outer surfaces at both ends (not shown) which are located in corresponding recesses in cylindrical sections 28, 29, thus allowing a ball and socket type movement between the plate 7 and the stator 5.

15 Referring to Figure 2, the apparatus 1 is suspended from a top drive (not shown) via connecting shaft 2. A tool 30 for engaging with a tubular is suspended from beneath the rotor 6 of the hydraulic motor 4. Such a tool may be arranged to be inserted into the upper end of the tubular, with gripping elements of the tool being radially displaceable for engagement with the inner wall of the tubular so as to secure the tubular to the tool.

20 In use, a tubular (not shown) to be connected to a tubular string held in a spider (not shown) is located over the tool 30. The tool 30 grips the tubular. The apparatus 1 and the tubular are lowered by moving the top drive so that the tubular is in close proximity with the tubular string held in the spider. However, due to amongst other things manufacturing tolerances in the tubulars, the tubular often does not align

perfectly with the tubular held in the spider. The suspension unit 3 allows minor vertical and horizontal movements to be made by using alignment pistons 31 and 32 for horizontal movements, and piston and cylinders 23 and 24 for vertical movements. The alignment piston 31 acts between the rigid body 15 and the plate 7. The alignment
5 piston 32 acts between the slider 16 and the arm 19. The alignment pistons 31 and 32 and pistons and cylinders 23, 25 are actuated by hydraulic or pneumatic means and controlled from a remote control device.

The piston and cylinders 23, 24 are hydraulically operable. It is envisaged however, that the piston and cylinders 23, 24 may be of the pneumatic compensating
10 type, i.e. their internal pressure may be adjusted to compensate for the weight of the tubular so that movement of the tubular may be conducted with minimal force. This can conveniently be achieved by introducing pneumatic fluid into the piston and cylinder 23, 24 and adjusting the pressure therein.

Once the tubulars are aligned, the hydraulic motor 4 and 4' rotate the tubular via
15 gearing in the stator 5 thereby making up the severed connection. During connection the compensating piston and cylinders 23, 24 expand to accommodate the movement of the upper tubular. The alignment pistons 31 and 32 can then be used to move the top of the tubular into alignment with the top drive. If necessary, final torquing can be conducted by the top drive at this stage, via rotation of the pipe 27, and the main
20 elevator can also be swung onto and connected to the tubular prior to releasing the slips in the spider and lowering the casing string. It will be appreciated that the suspension unit 3 effectively provides an adapter for connecting a top drive to the tubular engaging tool 30.

CLAIMS

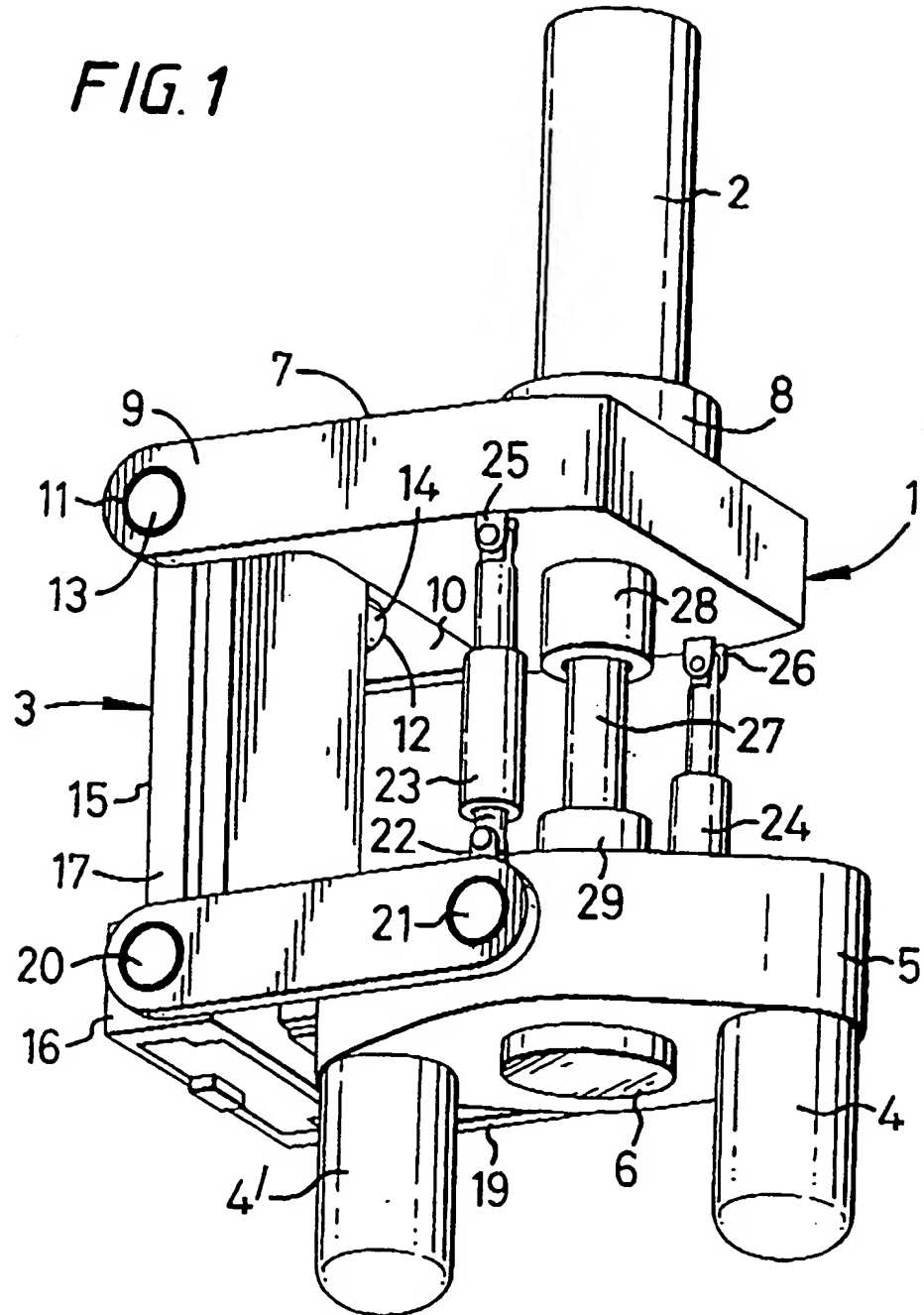
1. Apparatus for facilitating the connection of tubulars using a top drive, the apparatus comprising a motor (4, 4') for rotating a tool (30) for drivingly engaging a tubular, and means (3) for connecting said motor (4, 4') to said top drive, the apparatus being such that, in use, said motor (4, 4') can rotate one tubular with respect to another to connect said tubulars.
2. An apparatus as claimed in Claim 1, wherein said motor is hydraulically operable.
3. An apparatus as claimed in Claim 1 or 2, wherein said means comprises a suspension unit (3) which, in use, can move said motor relative to the axis of said top drive to facilitate aligning said tubulars.
4. An apparatus as claimed in Claim 3, wherein said suspension unit (3) is provided with at least one piston and cylinder (23, 24) in order to raise and lower said motor (4, 4').
5. An apparatus as claimed in Claim 4, wherein said at least one piston and cylinder can be pneumatically actuated to compensate for the weight of said tubular.
6. An apparatus as claimed in Claim 3, 4 or 5, wherein said suspension unit (3) comprises spherical bearings (20, 21) to allow movement of said motor in two planes.

7. An apparatus as claimed in any of claims 3 to 6, wherein said suspension unit (3) comprises adjustable pistons and cylinders (31, 32) to position said motor (4, 4').
- 5 8. An apparatus as claimed in any preceding claim, comprising a mud pipe (27) for delivering mud to said tubular.
9. An apparatus as claimed in Claim 8, wherein said mud pipe (27) is provided with a ball joint (28, 29) at both ends thereof.
- 10 10. An apparatus as claimed in any preceding claim, when supported by a top drive.
11. A method of connecting first and second tubulars for use in lining a borehole, the method comprising:
- 15 coupling said first tubular to a top drive using a suspension unit, wherein the tubular engages the rotor of a motor supported by the suspension unit;
- engaging a lower end of said first tubular with an upper end of said second tubular;
- rotating said first tubular using the motor so as to screw the tubulars together;
- 20 and
- tightening the connection between the tubulars by rotating the first tubular using the top drive.

12. A method according to claim 11, the method comprising adjusting the suspension unit prior to tightening the connection using the top drive so as to bring the first tubular into alignment with the top drive.

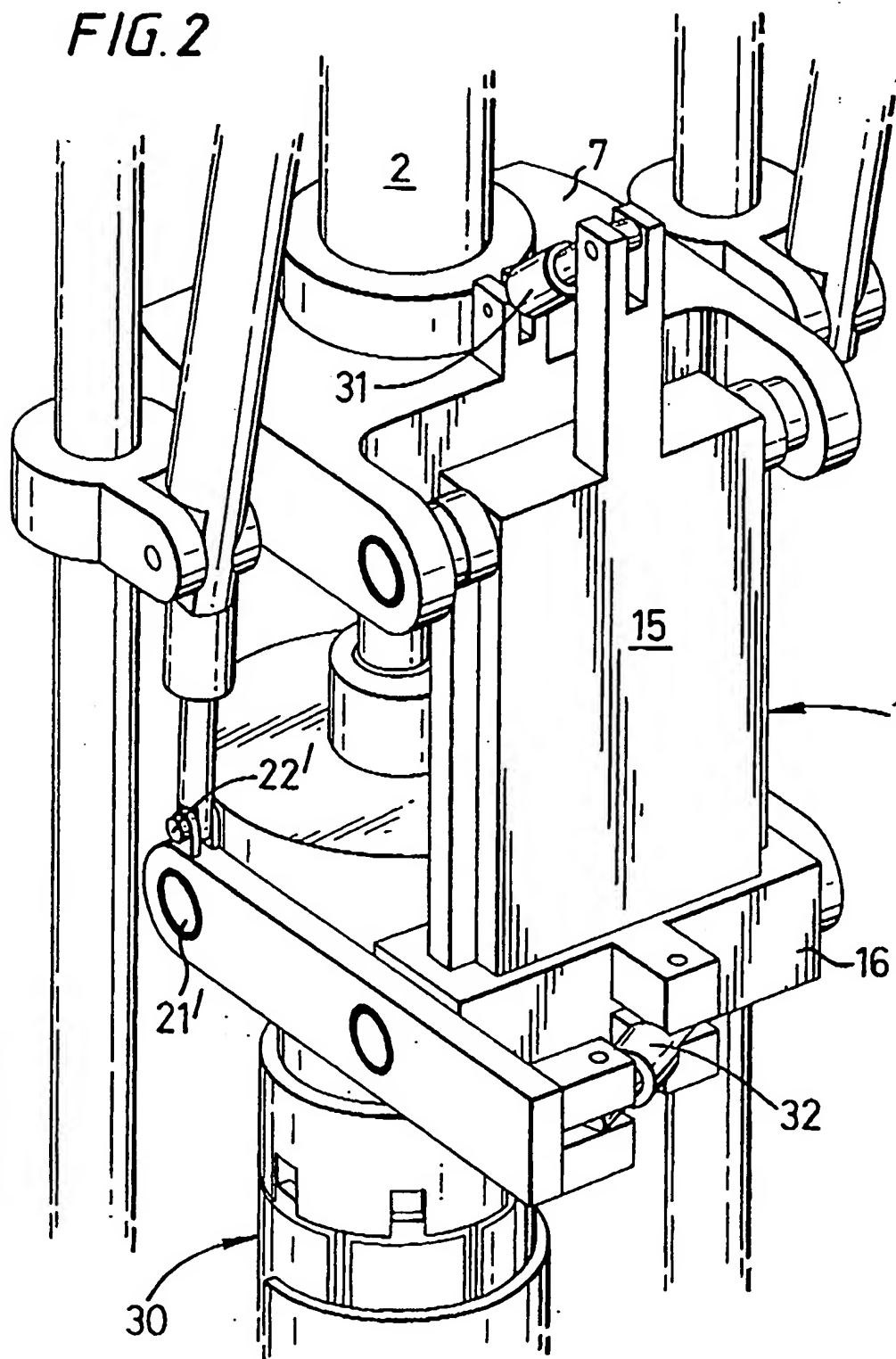
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FIG. 1



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FIG. 2



INTERNATIONAL SEARCH REPORT

International Application No

1 /GB 99/02708

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E21B19/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 625 796 A (BOYADJIEFF GEORGE I) 2 December 1986 (1986-12-02) column 3, line 19-52 column 6, line 1-21 figures 1,2 ---	1,2,8
X	US 4 449 596 A (BOYADJIEFF GEORGE I) 22 May 1984 (1984-05-22) column 11, line 33-59 ---	1,8
X	US 3 766 991 A (BROWN C) 23 October 1973 (1973-10-23) abstract column 5, line 13-42 figure 1B --- -/--	1

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A	US 4 813 493 A (SHAW DANIAL G ET AL) 21 March 1989 (1989-03-21) abstract; figure 1 ---	1,11
A	US 5 388 651 A (BERRY JOE R) 14 February 1995 (1995-02-14) column 7-8 figures 1,2 -----	1,11

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

1 :/GB 99/02708

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4625796 A	02-12-1986	CA 1250569 A EP 0202184 A JP 1752104 C JP 4034672 B JP 61233194 A NO 177018 B	28-02-1989 20-11-1986 08-04-1993 08-06-1992 17-10-1986 27-03-1995
US 4449596 A	22-05-1984	CA 1194855 A DE 3327739 A DE 3347970 C DE 3347971 C DE 3347972 C FR 2531479 A FR 2565287 A FR 2565288 A FR 2565289 A GB 2124680 A,B GB 2152106 A,B GB 2152107 A,B GB 2152108 A,B JP 1436263 C JP 59044487 A JP 62045392 B NO 832774 A NO 854202 A NO 854343 A NO 854358 A	08-10-1985 16-02-1984 06-11-1986 30-10-1986 30-10-1986 10-02-1984 06-12-1985 06-12-1985 06-12-1985 22-02-1984 31-07-1985 31-07-1985 31-07-1985 25-04-1988 12-03-1984 26-09-1987 06-02-1984 06-02-1984 06-02-1984 06-02-1984
US 3766991 A	23-10-1973	NONE	
US 4813493 A	21-03-1989	WO 8808069 A NO 885529 A	20-10-1988 13-12-1988
US 5388651 A	14-02-1995	NONE	

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